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IMPACT OF PLANT GROWTH HORMONE, INDOLE-3-ACETIC ACID (IAA) ON THE ORGANIC CONSTITUENTS OF SILKWORM, *BOMBYX MORI* L

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ABSTRACT

The impact of indoe-3-acetic acid (IAA) fed through mulberry on the organic composition of silk gland of silkworm larvae has been studied. The increase in the total proteins, total carbohydrates, glycogen, Trehalose and decrease in the free glucose content of silk gland indicates that IAA favored stimulatory effect on synthesis of silk proteins which might influence on the quality of silk. The increase in protein content of silk gland indicates either its active uptake from haemolymph for utilization at cellular level or decreased proteolysis of silk gland. The increase in the total carbohydrate content of silk gland indicates that IAA favored stimulatory effect on cocoon crop production and seem to have improved the biosynthetic activities of silk gland. The decreased free glucose content observed in the silk gland of IAA treated larvae indicates its possible increased re-cycling of glucose during IAA supplemented conditions. The increase in glycogen content might have resulted from the increased breakdown of glycogen and or decreased synthesis under the influence of IAA. The increase in the biochemical composition was correlated with the observed increase in the body weight and silk output.

KEYWORDS: Silkworm, *Bombyx mori* L, Indole-3-Acetic Acid (IAA), Total Proteins, Total Carbohydrates, Free Glucose, Glycogen and Trehalose

Objectives

- To study the effect of indole-3-acetic acid (IAA) on the organic constituents of the silkworm *Bombyx Mori* L.
- To test the efficacy and final suitability of indole-3-acetic acid (IAA), so as to take the findings from lab to land
- To identify the effective use of indole-3-acetic acid (IAA) for the benefit of sericulture industry.

INTRODUCTION

The plant hormones are the growth regulators that regulate or control the growth and development in the plants. The first plant hormone to be identified was the auxin (Paul *et al*, 1979). Auxin appears to be a master hormone, exercising regulatory action over many different sorts of plant processes and probably over many of the other plant hormones (Bonner and Galston, 1951). Auxin has more effect than the other growth regulator, gibberelines (Bernad *et al*, 1973). The only one compound, Indole-3-acetic acid (IAA) has been positively identified as a major naturally occurring auxin synthesized in plants (Bernard *et al*, 1973). IAA is believed to be derived from tryptophan through decarboxylation and deamination reaction to Indole-3-acetaldehyde which is then oxidized to IAA. This occurs chiefly in young growing tissue such as stem tips, young leaves, flowers, embryos and root tips (Paul *et al*, 1979).

In silkworm organic compounds such as proteins and carbohydrates are playing an important role in the progressive growth of the larvae (Narasimha Murthy *et al*, 1987). Glycogen forms an important carbohydrate reserve in insect tissues. Wigglesworth (1965) reported that glycogen gets deposited in the abdominal fat body of Drosophila. The role of fat body glycogen as a chief source of energy in physiological activities of insects has been confirmed (Kilby, 1965). Glycogen is known to play major role in inset muscle contraction (Sacktor, 1970) as evidenced by the presence of phosphorylase activity in tissues of silkworm (Shigematsu, 1956 and Ito and Horie, 1959).

Trehalose is considered to be a metabolically active carbohydrate because of its active biosynthesis in fat bodies of insects (Clegg and Evans, 1961). Trehalose the predominant physiological sugar in haemolymph, served as an initial substrate for carbohydrate metabolism in various tissues of many insects including the silkworm (Wyatt, 1967 and Friedman, 1970).

MATERIALS AND METHODS

Polyvoltine pure breed of silkworm *Bombyx mori* L of the race Pure Mysore was used in the present study.

IAA Treatment

The larvae were separated into three groups and IAA was given to the silkworm larvae. Each group consists of three replication each of 200 larvae for each treatment. Fresh mulberry leaves were dipped at least for one hour in Indole-3-acetic acid solution having a concentration of 15µg/lit. The treated leaves were shade dried and they fed to the silkworm larvae on the first day of the third and fourth in stars, and daily during the fifth in star upto 7 days. Optimal conditions were maintained throughout the rearing period. The control larvae were fed with mulberry leaves soaked in physiological saline. The matured fifth instar silkworm larvae of silk gland were collected and used for the present investigation.

Total proteins (Lowry *et al*, 1951), total carbohydrates (Carroll *et al*, 1956), free glucose (Mendel *et al*, 1954), glycogen (Kemp and Van Heijningen, 1954) and trehalose (Saito, 1963) were estimated in the silk gland of control and experimental silkworm larvae.

RESULTS

- The data presented in the Table 1 and 2 and Figure 1 and 2 reveal the extent of changes in the total proteins, total carbohydrates, free glucose, glycogen and trehalose in silk gland of silkworm larva, *Bombyx mori* L of the control and IAA treated fifth in star larvae.

Total Proteins

- The significant increase was noticed in the total protein content of silk gland ($P<0.001$). The per cent increase in protein content was 28.39 in silk gland after IAA treatment.

Total Carbohydrates

- The total carbohydrate content in silk gland was significantly increased ($P<0.001$). The per cent increase was 42.30 in silk gland over control.

Free Glucose

- The significant decrease was observed in free glucose content of silk gland after IAA treatment. The per cent decrease in the free glucose of silk gland was 23.52 over control

Glycogen

- The per cent increase in the silk gland was 42.35 was noticed after IAA treatment.

Trehalose

- The significant increase was observed in trehalose content of silk gland after IAA treatment. The per cent increase was 36.36 over control.

DISCUSSIONS

The effect of indole-3-acetic acid (IAA) on the organic constituents of silkworm, *Bombyx mori* L. were studied.

Proteins are the organic constituents of the cell. Proteins provide the structural elements for the muscle, glands and other tissues. These macromolecules are concerned with the regulation of all biochemical events in the organisms (Harper *et al*, 1993). Elevation in the levels of proteins suggests increased protein synthesis. The increase in protein content of silk gland indicates either its active uptake from haemolymph for utilization at cellular level or decreased proteolysis of silk gland. The proteins of intestine, haemolymph and fat body may provide the raw material for the synthesis of silk protein in the silk gland (Das, 1987). IAA possibly stimulates protein synthesis in fat body leading to an increase in its protein content and consequently more protein is released into the haemolymph from this organ. Thus the present result of enhancement of proteins in silk gland may be supported by the mobilization of more proteins from the haemolymph and fat bodies of IAA treated silkworms.

The increase in the total carbohydrate content of silk gland indicates that IAA favored stimulatory effect on cocoon crop production and seem to have improved the biosynthetic activities of silk gland. The total carbohydrate content was markedly elevated in silk gland. The total carbohydrate content of the silk gland was elevated over the control suggesting their active uptake from the haemolymph (Chaudhuri and Medda, 1993). The increase in carbohydrate reserves in the treated tissue is due to increased gluconeogenesis and high glycogenesis activity (Sailaja, 1999).

The decreased free glucose content observed in the silk gland of IAA treated larvae indicates its possible increased re-cycling of glucose during IAA supplemented conditions. Glycogen is a storage polysaccharide found in the animal tissues. It is hydrolyzed by amylase and phosphorylases. The levels of glycogen are related to the secretion of insulin and glycogen. The amount of glycogen in an organ is the result of the processes of glycogenesis and glycogenolysis. If any substance increases the amount of glycogen, it may be suggested that this is due to increased synthesis and /or decreased degradation. The utilization of glycogen mainly depends upon the nutritional demand of the insect body. The increase in glycogen content might have resulted from the increased breakdown of glycogen and or decreased synthesis under the influence of IAA. The increase in silk gland glycogen might be due to active movement of haemolymph trehalose to silk gland for fibroin synthesis (Furusawa *et al*, 1993).

Trehalose is a major carbohydrate and important reserve metabolite in insects. Trehalose is an important carbohydrate reported to be present in the blood of insects including *Bombyx mori*. It has been demonstrated that trehalose

is actively synthesized in the fat bodies of insects and it rapidly decreases during active movement and starvation (Clegg and Evans 1961; Saito 1963). Elevated trehalose content was observed in silk gland after IAA treatment. The levels of trehalose also showed a similar trend as that of glucose in all the tissues showing elevation over the controls on treated with IAA. Higher content of trehalose indicates the energy demand of the insect. The elevated trehalose content in silk gland when treated with IAA activates trehalose formation to meet the energy demands for silk synthesis in larvae. It was reported that trehalose diffuses from the haemolymph according to the concentration into the gut and then degrades into glucose to meet the energy needs (Jabbar and Mahamed, 1990).

The fortification of mulberry leaf with indole-3-acetic acid (IAA) has proved to be successful in improving the crop yield. Hence IAA can be utilized in sericulture for the improvement of yield and has practical advantage in grainages and reeling industry. IAA showed significant development in terms of productivity and quality right from cocoon production to processing of silk. The plant growth hormone, IAA can be effectively used in sericulture for the benefit of the industry after large scale trials. Since the research work involves the improvement of industry it has R & D importance.

CONCLUSIONS

The increase in the weight of larva, weight of silk gland, weight of cocoon, total proteins, total carbohydrates, glycogen, trehalose and decrease in the free glucose content of silk gland indicates that IAA favored stimulatory effect on synthesis of silk proteins which might influence on the quality of silk. The indole-3-acetic acid exerts preformed influence on the silk gland which reflects on the silk yielding potential and reproductive performance of the silkworm. Hence it can be concluded that IAA acts as an inducer of tissue oxidative metabolism and it enhances the organic constituents leading to the accelerated growth of silkworm.

Table 1: Effect of IAA on Larval Weight at Fifth in star (Mg), Cocoon Weight (Mg) and Silk Gland Weight (Mg), in Control and Experimental (IAA Treated) Larvae. Values are the Mean of 10 Individual Observations. Mean ± S.D; '+' and '–' Indicate Percent Increase or Decrease Respectively Over Control. 'P' Denotes the Statistical Significance

S. No	Component	Control		Experimental (IAA Treated)
1	Larval weight at fifth instar	1576.31 ± 35.41	+ 17.25 P<0.001	1848.30 ± 42.66
2	Cocoon weight	843.29 ± 23.40	+ 16.77 P<0.001	984.74 ± 32.57
3	Silk gland weight	438.87 ± 12.63	+ 31.32 P<0.001	576.35 ± 14.58

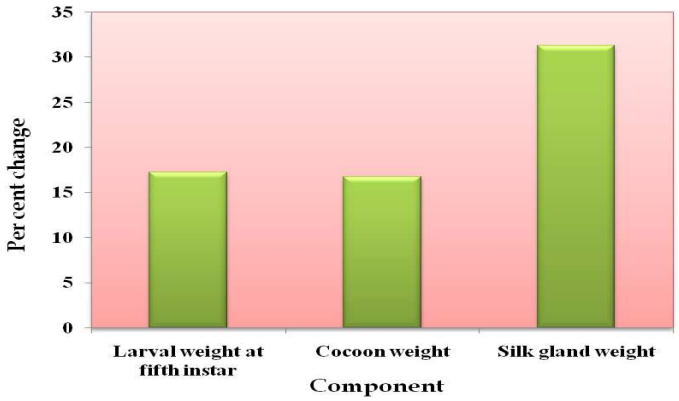

Figure 1

Table 2: Changes in Levels of Total Proteins, Total Carbohydrates, Free Glucose, Glycogen and Trehalose (mg/gm Wet Wt) in Silk Gland of Control and Experimental (IAA Treated) Larvae during the 5th Instar of Silkworm, *Bombyx Mori* L. Values are the Mean of 6 Individual Observations. Mean ± S.D; '+' and '–' Indicate Percent Increase or Decrease Respectively Over Control. 'P' Denotes the Statistical Significance

S. No	Component	Control		Experimental (IAA Treated)
1	Total proteins	118.77± 5.45	+28.39 P<0.001	152.49± 9.78
2	Total carbohydrates	3.64 ± 0.24	+42.30 P<0.001	5.18 ± 0.36
3	Free glucose	0.51± 0.038	-23.52 P<0.001	0.39 ± 0.027
4	Glycogen	0.085 ± 0.007	+42.35 P<0.001	0.121± 0.010
5	Trehalose	8.69 ± 0.37	+36.36 P<0.001	11.85± 0.89

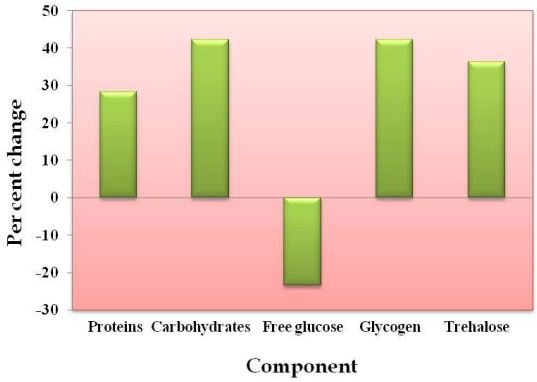

Figure 2

Figure 3: Silkworms

Figure 4: Cocoons

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